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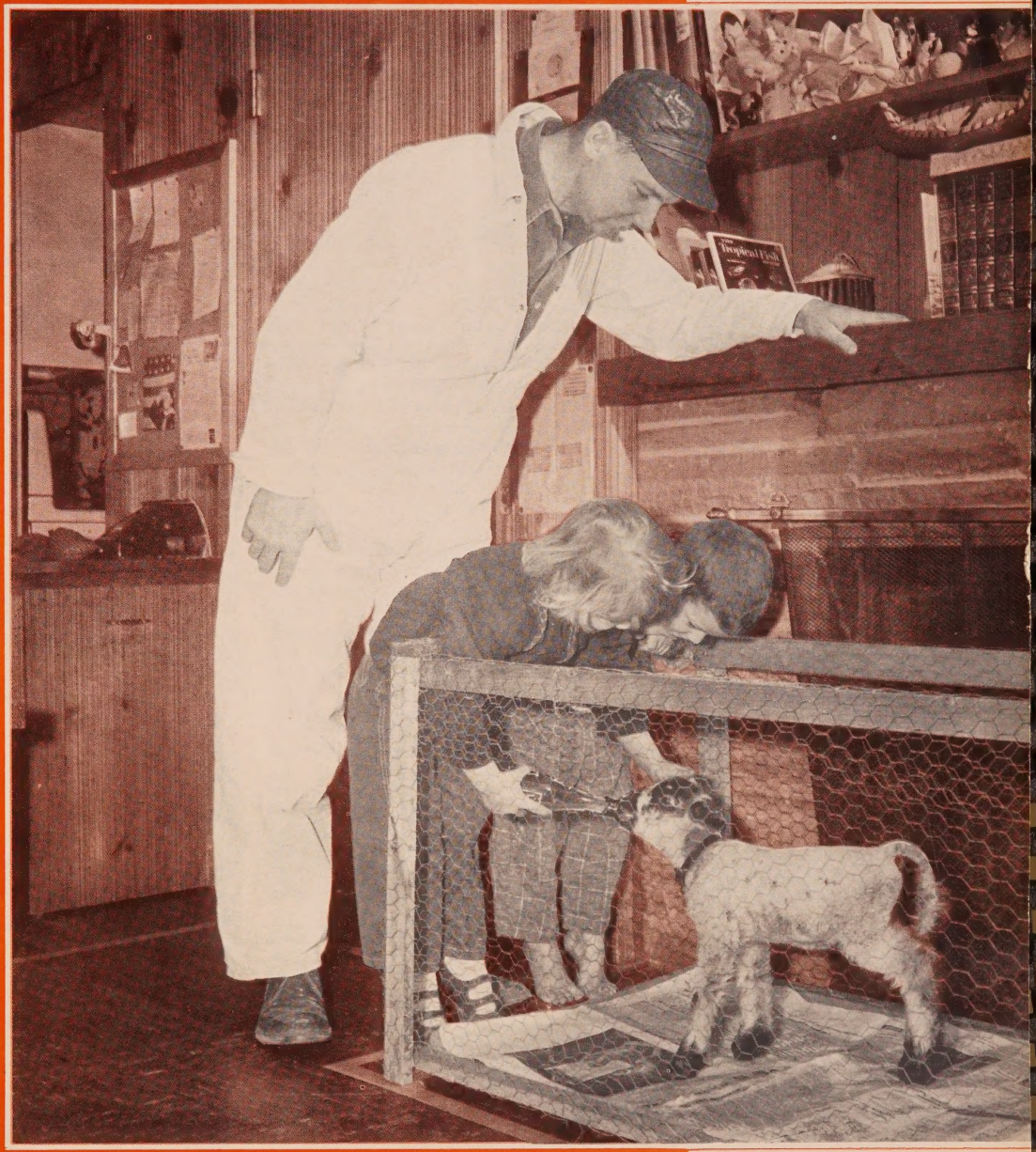
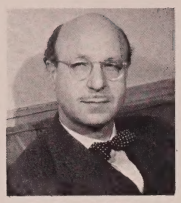


VETERINARIAN GAINS LEISURE TIME WITH TWO-WAY RADIO SYSTEM

Cover Story Pages 4 & 5

Positive or Negative!



D. E. NOBLE

Man's disciplined search for knowledge develops the pattern called "Science." Engineering is the process of putting science to work. Science and engineering are partners, with both the independence and interdependence characteristic of partnerships. Engineering often leads to scientific discoveries, and certainly the instrumentation, the tools and the products of engineering serve as basic elements implementing scientific research.

There are those who fear that basic scientific research will be neglected in the search for commercial products and that our engineering progress must ultimately starve and stagnate. The inter-dependence of the two makes such a possibility improbable. The emphasis at one time will be on application and at another upon pure research. As scientific applications reach a saturation of available information, the emphasis will turn to pure research. In times of rising correlation of new areas of scientific knowledge, there will be a blossoming of engineering advances. Such cycles of emphasis are normal phenomena.

During the past ten years, we have witnessed the rise of engineering applications which are having a profound effect upon our social, political and economic lives. The atomic bomb, guided missiles, jet planes faster than sound, monochrome and color television, are all products of the engineering art.

The effects of science and engineering upon our daily lives are more widespread, continuous and far-reaching than the temporary perturbations produced by the political maneuvers of the diplomats and the politicians. A negative view would call attention to the destructive potential of science and engineering products and cite as proof the power of atomic bombs, the jet planes and the guided missiles. The constructive interpretation will see the magic of science and engineering in *enhanced communications* and point out that communications is the most powerful force for ultimate peace in the world.

In the early days of our republic, war between the states was always a possibility, but today the idea is absurd. It is absurd primarily because the railroad, the automobile, the airplane, ships, trucks, busses, telegraph, telephone, radio, television, mail, magazines, and newspapers, have interlaced our country into a tightly bound community of common information and understanding.

The atomic bomb may be a possible device for horrible destruction, but it also brings with it, atomic energy for new sources of power, new techniques, new instruments, and new methods in medicine, agriculture, and industry, and new tools for further research to bring us continued expansion of our pattern for science. Jet planes and guided missiles carry the promise of faster, safer transportation for passengers, mail and express. Worldwide television will someday make neighbors of people separated by the far reaches of the earth. Someday war between countries will be as absurd as war between our states. Someday! But the unknown factor in our prediction is time. Will we have time to knit the world together by an encompassing cover of communications similar to the one we have developed over the United States, before we are stopped by an atomic war? Perhaps another fifty years would achieve our purpose. While it is true that we have not made much progress in two thousand years, our pace has accelerated. In the past fifty years we have made more progress in the control of our environment than in the entire prior history of the world. Scientific information builds upon scientific information, and with effective communication, the accumulation of sound basic patterns results in the mushrooming of scientific knowledge. Time is still the big question; will we have the time, even with this accelerated pace of science and engineering? Unless we can hold back the ever-present danger of the atomic bomb, we will not have the fifty or hundred years required to achieve a peaceful world community through communications. That is why we must not lag in the development of our striking power and of our defenses. The bandit nations must be controlled, or science and engineering, the greatest forces for ultimate peace, will become the chief instruments of world destruction. The scientists and the engineers are, therefore, in the anomalous position of producing the most powerful, the most destructive, the most terrible and the most effective weapons ever dreamed of, in order that they may, through this means, buy time to develop a pattern for peace.

Communications in the generic sense includes all transportation, whether it is the transportation of television pictures, letters, voice, passengers or radio waves. I wish to emphasize the fact that electronic brains control nearly all modern communication systems. You know that there is a rising application of radio communications for the control of trains, busses, trucks and airplanes. Ships have always depended upon radio communications. The electronic art dominates the field of guided missiles and jet plane control. Of course, the modern telephone, radio, monochrome and color television fields, are entirely dependent upon electronics. As we speed up communications, the need for instantaneous response produces a natural trend toward electronic devices and, in the future, when our mail is delivered by guided missiles and we travel across the country in jet planes, electronic devices will be at the controls.

To electronics, more than to any other field of science and engineering, must fall the task of holding back the bandit nations while we build our pattern of communications for peace.

Dan Noble

The
Motorola Newsgram

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Technical Information Center

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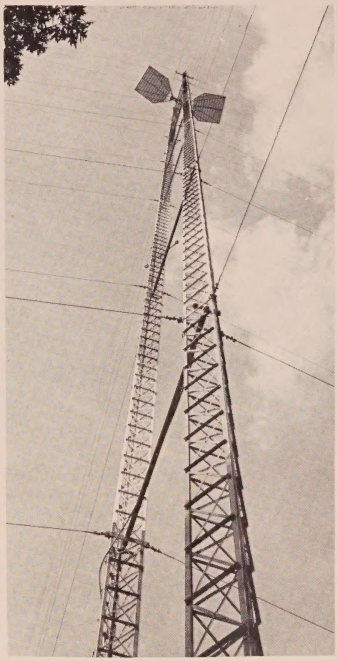
Utility Modernizes Communication System

Kentucky Utilities Company with headquarters in Lexington, Kentucky recently announced plans to modernize its communication system by installing a 150-mile, seven station microwave system.



The new system, manufactured by Motorola, is scheduled for completion by mid-1955.

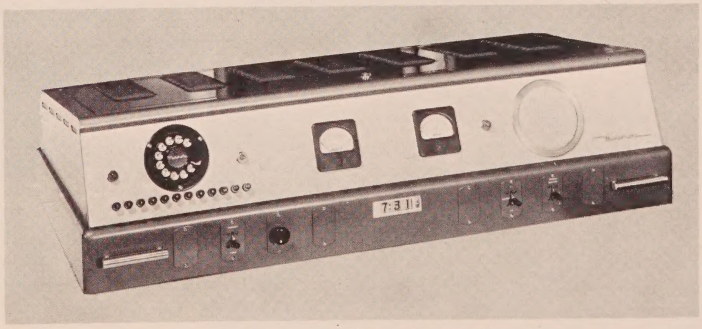
The system will utilize 15 channels and will have an ultimate capacity of 24 channels. These channels provide facilities for voice circuits, telemetering and remote control of VHF base stations.

Microwave systems of this type have proved themselves through years of service in the power utility industry. The Ohio Power Company, Central Illinois Public Service Company and Dayton Power and Light are but a few of the many power utilities using this type of communications to speed operational messages over great distances.

Radiation Monitor Developed by Motorola

Motorola has recently developed for the Bureau of Standards a new, custom built, radio-controlled radiation monitor. The system, designed for the Atomic Energy Commission for use in nuclear tests, automatically measures radiation intensities, weather conditions and other variables in the vicinity of an atomic explosion and transmits all data to headquarters.

This remote interrogation system is an adaptation of Motorola's standard VHF communications equipment operating in the 162-174 mc. frequency band.



Control console at centrally located headquarters.

HOME IS WHERE THE DOC IS

veterinarians make more calls, gain extra leisure time at home with their mobile radio 'vet net'

Three progressive Illinois veterinarians are using whips to earn more money for fewer hours of work.

Not for balky horses, these whips. The vets rely on the whip antennas on their automobiles—the only outward signs that the men of the Milledgeville Veterinary Clinic are radio-active.

Drs. Donald W. Rawson, William K. Specht and G. C. Poppenhouse have built their small-town veterinary practices into a flourishing business, and they make no secret of their less-work/more-pay formula. It is the Motorola two-way radio system that keeps the doctors in constant touch with their office and with customers in a 20-mile radius around Milledgeville.

Rawson started with a base station in his downtown office in 1951, soon after the Federal Communications Commission allotted special emergency frequencies to physicians and veterinarians whose practice is mainly in rural areas. His original mobile fleet was two radio-equipped autos, for himself and for his breeding technician, Virgil Knapp. When he went into partnership with Drs. Specht and Poppenhouse, the radio system was expanded to include their cars.

Rawson had reached for radio as a way of cutting down the terrific pressure which kept him on the road 15 hours a day. Did radio help? In the first year his two-way communication system was in use, Rawson saw his income jump more than a fourth, while he was gaining two extra hours a day at home with his family.

Canny Illinois farmers have learned that a call to the radio-dispatched veterinarians nearly always finds the doctors "in." That's important to dairy cattlemen, when a couple of hours delay in treatment can mean loss of an animal worth hundreds of dollars. Even when all three veterinarians are out making their rounds, the office attendant, Mrs. Julia Frederick, can guarantee fast action on calls.

As a result of their increased business, the doctors were encouraged to build a new office and clinic on the outskirts of Milledgeville. The radio equipment was built-in when the clinic was under construction. A 60-foot telephone pole supports the base station antenna. A Motorola 60-watt FM base station serves as the heart of the radio network.

The doctors and the breeding technician each have 30-watt two-way units in their cars. Each man checks in with the office as soon as he completes a visit, and Mrs. Frederick relays other calls in his area to be made on the way in. This cuts "dead" travel and doubling back along the same route—and those miles saved mean real money to the Illinois veterinarians, who estimate auto-

mobile costs over country roads at a minimum of 10c per mile.

All sets operate on the same frequency—47.66 megacycles—so that the men can talk to each other or to the base station at all times on the same channel. In addition, each doctor has a remote control consolette at his home, connected by telephone line to the base station, so that the doctor (or his wife) can send messages along to the mobile units at any hour, day or night.

By pressing an "intercom" button at the home stations, the doctors talk directly with each other and with attendants at the clinic in a private round-table which doesn't go out on the air.

The doctors took to use of radio like a pony takes to sugar. Their messages crackle through the loudspeaker crisply. To save time and misunderstandings, they use code numbers to identify the unit calling, the station spoken to, and the message.

The wives are big boosters of the radio system. There's no waiting to find out whether hubby will be home on time for meals. Since the home consolettes hear all calls, the doctors frequently include information to their wives when they call in from the road.

The performance record of the Motorola radio equipment has amazed the doctors. The main transmitter, in use since early in 1951, has been shut down less than a week all told. And "down time" for the mobiles is negligible. Knapp, for example, drove his auto 45,000 miles in one recent year, and the radio did not need servicing a single time.

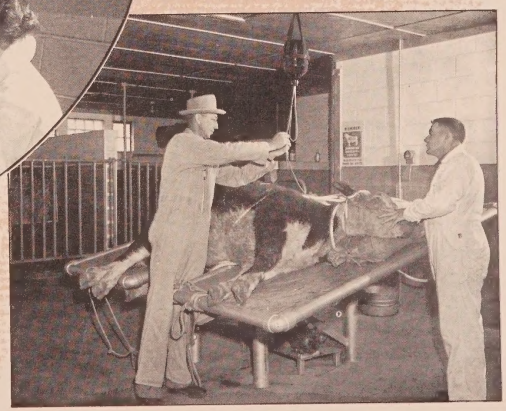
His radio is nice company, Rawson has discovered, especially when the gas tank unexpectedly runs dry far from town. He has called for road service more than once.

To the rural veterinarians, radio is more than a gadget. It is becoming a necessary accessory to their livelihood and their leisure.

Dr. Donald Rawson installed first car transmitter-receiver in 1951, found two extra hours a day to spend at home with family, while his income rose.

Remote control consolette in Rawsons' kitchen keeps wife in touch with the doctor, serves as radio network control center after clinic office hours.

Nurse Julia Frederick operates station located at new clinic. She relays calls to doctors while they are out making calls at Illinois dairy farms.



Right: Typical of rural vets' ingenuity is this hydraulically tilted operating table in the new Milledgeville clinic. Dr. G. C. Poppenhouse, left, and Dr. William K. Specht treat ill steer on table.

RIGHTS VS. RESPONSIBILITIES

FCC Official Warns Public Safety Licensees Against Relinquishing Control of Radio Systems.

Colonel Edwin L. White, chief of the FCC Safety & Special Radio Services Bureau, gave the following address at the 1954 national conference of Associated Police Communication Officers, Inc., in Pittsburgh, Pa., early in August.

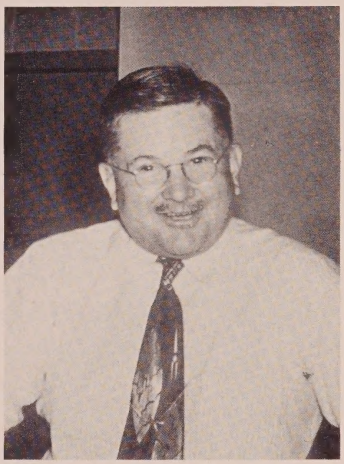
* * *

They tell the story about an Irishman, a recent immigrant, who got into a fight in New York and poked another Irishman in the nose. When he appeared in court, he objected to the treatment he had received, claiming that this was a free country. The judge agreed that it was a free country but informed the Irishman that his freedom ended where the other man's nose began.

Sometimes the border line between rights and responsibilities is not as clear as the end of an Irishman's nose. I would like to talk about the rights of public safety departments to run their systems as they please, and their responsibilities in the field of communications.

LICENSEE RESPONSIBLE

There has been much talk pro and con on the question of the propriety of lease and maintenance contracts, much of it intemperate and conducted without adequate consideration of the facts. No one as yet has really questioned the right of a licensee to enter into lease and maintenance contracts. What is questioned is whether under such contracts the licensee loses his ability to carry out his responsibility. What I shall endeavor to do is to explore the factual situation in such a manner as to make it possible for you to reach your own conclusions as to whether and under what circumstances that right may properly be exercised.



Before discussing contracts I would like to discuss responsibilities.

The responsibility most important to you communications officers is that which the administration of a police department, a fire department, a municipality or State has to its tax payers. The chief of police aided and supported by the city fathers has the responsibility to see that his police department is ready, able and willing to enforce the law, in spite of hell or high water. He should consider carefully whether any arrangement he may make would impair his ability to carry out this responsibility. This is true whether the arrangement is reduced to writing in the form of a lease or maintenance contract, or is in an unwritten understanding over and above the terms of that contract.

In addition to this responsibility, of course, there is a responsibility in which I am greatly interested. That is the responsibility of a licensee under the Communications Act for the proper operation of a licensed radio station. This responsibility cannot be relinquished directly or indirectly without the prior consent of the Commission. It makes no difference what the salesman for a service company says about his ability to take care of things—even though he assures the licensee that as far as the licensee is concerned this apparatus will be just like another telephone, and that he will have no further worries with the FCC or anyone else. But when the chips are down, if the station is improperly operated or is involved in a violation, it will be the licensee who has to answer to the Commission. He will be unable to get out from under by saying that "Jim told me everything would be taken care of."

CONTROL LOST

For many years police departments have leased equipment and

entered into contracts for the maintenance of that equipment. It has been said that there is nothing basically wrong with such contracts. To an extent this may be true but, certainly, if a man does not own equipment, regardless of the nature of his contract with the person who does, he loses some measure of control over that equipment. And if a man cannot hire and fire the people who are maintaining his equipment, he has lost some measure of capacity to insure the technical quality of the operation of that equipment regardless of the terms of the contract. The important question is whether the loss is material—whether the **gains** more than compensate for the **loss.**

With respect to equipment contracts, and I think they should be discussed separately from the maintenance contracts, there are many variations. If it seems most important for you to exercise your right to lease your equipment, do not forget your responsibilities. Whether a conditional sale or outright rental contract is used, it must insure the licensee's right to do with the equipment as he pleases in exactly the same manner as if he owned it.

Suppose a supplier offers a rental or sales contract and then puts all kinds of gimmicks in it which impair the rights of the licensee, such as right of repossession under other circumstances than failure to meet payments, right to supervise maintenance, et cetera. Do you want to give up your responsibility to the tax payer? Do you want to take the chance of violating the law defining your responsibility to the FCC?

NO INTERFERENCE

Or should you say, "You're leasing this equipment to me to use as I see fit. If you think your property rights are being invaded by the way I use it, you may have recourse to civil suit, but I cannot tolerate a situation in which you can come in without warning and interfere with my ability to render service to my principals."

In so far as the necessity to hold control in the hands of the licensee the maintenance contract is the same. However, it may be more difficult under such a contract to insure ability to carry out such responsibility. It is true that, if you are running a small fleet and if a taxicab company, a telephone company, a power company, or some other organization in your city is also running a fleet of similar vehicles, it will be much cheaper for two or more of you to pool your interests, equip a single maintenance shop and share the use of a single facility.

But if that is done, if a fire truck or a police car's equipment breaks down what assurance have you that it will be fixed right away? Perhaps some other job is on the bench. Further, supposing you were in such an organization and the employees involved get in a serious argument, not with you, but with your partner, and go on strike, what happens to you? You have the right to endeavor to make a contract that has these answers if you wish, but when you do, do not forget your responsibilities.

There is another point to be remembered in both equipment and maintenance contracts. Supposing you enter into a contract which leaves you responsible and is entirely satisfactory to start with, but at the end of the contract, say one, two, three or four years later, you decide that some other contractor offers a more advantageous scheme, or that it is more advantageous to own and operate your own equipment, or perhaps the contract is not renewable on a reasonable basis.

INTERRUPT SERVICE?

Will you be able to change contractors or install your own equipment and establish your own maintenance facilities simultaneously with the withdrawal of the old contractor, or will there be a hiatus? And if there is a hiatus, is it important? Or have your operations become so dependent upon, and so integrated with, radio that the withdrawal of radio communication courts disaster? Also, suppose that an apparently reliable and solvent contractor fails and goes out of business, are you protected? If you have a performance bond, how will the bondsman take over without a delay?

There is another phase to the lease and maintenance contract which has been disturbing to many people. That is the offer of common carriers to render a service on frequencies allocated for non-common carrier use. This uneasiness has been abetted by the attitude of some of the common carriers involved. They are not content to be purveyors of equipment and technical skill as are other organizations, but seem to think that they are rendering a telephone communications service such as they could offer on their own frequencies.

MISREPRESENTATION

For example, I just saw an advertisement of one of the major telephone companies regarding a system that is operated, presumably, under a lease and maintenance contract for the benefit of one of our industrial licensees. This literature spoke of the "X

Continued on page 31

MORE PROFIT OVER the HORIZON

Indiana LP Gas Dealer Expands Delivery Area With Mobile Radio

* 2 delivery trucks do the work of 3.
* Customer radius extended another 20 miles.
* Accounts receivable cut 40 per cent.
* Telephone toll calls eliminated.
* Driver overtime cut to zero.

Pipe dreams of a propane dealer? Not to Charles J. Bucko, Sr., an expansion-minded LP gas operator in Gary, Indiana. These are accomplished facts, and his business records prove it.

When Bucko opened Pennant Gas & Fuel, Inc., in 1947, he was told that 25 miles from home base was just about the maximum distance his delivery trucks could cover efficiently. Beyond that range his vehicles would be "lost" a large part of the time, telephone tolls would outdistance profits, and costly dead miles between stops would offset the gain of a few customers.

Some men might accept the range limitation. Not Bucko. He went looking for a range expander, and found it in two-way radio.

Late in 1949 Pen-Gas went on the air with a Motorola 60-watt FM base station and mobile units in two bulk delivery trucks. Productivity of the trucks climbed to the point where each was delivering half again as much propane as it had done before getting the radio.

Bucko's original idea was to use the radio for dispatching call-in orders not on the driver's degree-day route sheet. He soon discovered the radio was good for that job and many more, besides.

For example, the radio-equipped drivers check with the bookkeeping department whenever there is a question concerning customers accounts. Pennant's collections are much better with radio. Where long-owing customers formerly kept Bucko's accounts receivable at $13,000 or more monthly, the instant check-up feature of two-way radio has enabled Pen-Gas drivers to slash that figure to about $8,000 now.

Driver Robert Bucko checks in with dispatcher easily, whether 1 block or 40 miles away from Gary headquarters.

Trucks are no longer "lost." With the radio, office personnel in Gary now can pass along last-minute orders to drivers as far as 40 miles away. Time spent hunting drivers by telephone from farm to farm along the route is saved. "We find that 50 per cent of the time our driver will pass within a block of the call-in customer's house," says Bucko.

Drivers formerly called the office every couple of hours throughout the day. As the truck fleet grew, the toll calls were costing Pennant quite a sum every week. Now that the radio is available, drivers call in each time they make a stop—and at no toll cost at all. Occasionally, a driver will outrun the Gary base station's radio range. When that happens, a message between driver and the Gary office may be relayed by one of the trucks in between, or by stations at Pennant's branch stores at Crown Point and Hebron, Indiana.

The radio played right into Pennant's plan for winning new customers with personalized service. In Bucko's view, a propane tank which has run dry rates high priority from Pen-Gas drivers. The only call that gets attention even faster is one calling for emergency repairs, such as a gas leak or defective appliance. These hazards demand—and get—rush service. Of course, such fast service wins and keeps customers.

Bucko believes the Motorola radio system saves Pennant enough in drivers' time to more than offset his competitors' lower wages and longer work-week. Many of the LP gas distributors work their deliverymen 9 to 10 hours, six days per week for much less than the union scale Pennant pays its 40-hour-week drivers. With radio control, Pen-Gas trucks deliver as much propane between 8 a.m. and 3:30 p.m. as "isolated" trucks can unload working until 6 p.m.

Cutting costs still further are the miles saved with radio. Pennant Gas & Fuel trucks save 5 to 15 miles per day under radio-dispatch conditions, company records reveal.

After four years of radio control, Pennant's fleet has expanded to 10 trucks, all two-way radio equipped. The yearly gallonage runs comfortably into 7 figures. Bucko states unequivocably: "Two-way radio is responsible for 50 per cent of our company's growth because it gave our trucks more range."

Although the radio plays a big part in the business, the equipment doesn't occupy much valuable office space. The base station is housed in a compact table-top console tucked under a counter next to the cashier's desk.

All 10 mobile units and the three base stations in the system operate on a frequency of 35.94 megacycles.

A few months ago Bucko's base station radio survived a disastrous fire which destroyed the original 95-foot-high antenna tower. One piece of Motorola test equipment was scorched so badly that the plastic knobs melted off the control panel, then it was thoroughly soaked by firemen's hoses. Digging through the wreckage afterward, Pennant employees found the instrument and set it aside to dry. When it was plugged in, it still worked!

More than once Pen-Gas drivers have called in to report automobile accidents along the highways.

Bucko makes no bones about the value of the Motorola two-way radio system. "For our operation it's vital—we couldn't get along without it now."

About one-third of Pennant's business is in bottled propane. Radio-dispatched trucks shuttle between lake-front camps, industrial customers and residential users in Greater Gary vicinity.

Cashier Lillian Kostelnik doubles as radio dispatcher. Motorola 60-watt base station is conveniently mounted under counter at left.

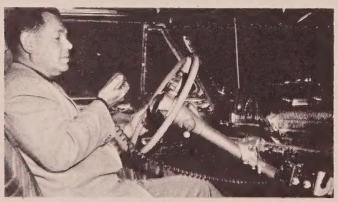
Movements of special bulk, self-unloading trucks are closely controlled by the 2-way radios installed in the farm supervisors' cars.

Red Dot Foods Inc.
Uses Two-Way Radio To . . .

CO-ORDINATE LARGE-SCALE FARM OPERATIONS

Control, and plenty of it, is given much of the credit by Fred Meyer for the growth of his small potato chip enterprise into a six million dollar a year party food business known as Red Dot Foods, Inc.

Because he found the quality of potato chips so dependent upon the potatoes from which they were made, he soon decided that it would be necessary to control his raw materials supply as well as the manufacturing and distribution operations. The result is the 15,000-acre Red Dot farm located near Rhinelander, Wis., where, under the direction of Dr. W. W. Weber, highly mechanized farming methods and scientific analysis and planning are used to produce fully mature potatoes with just the right percentage of total solids to yield the best quality potato chip.



Fred Meyer, president of Red Dot Foods Inc., demonstrates use of the radio which links all his farm operations together.

Each year about 700 acres devoted to this one crop produce some 200,000 bushels for use by the Madison, Wis. potato chip plants. To maintain fertility and control plant diseases, a three year rotation of fields is used, the other two years being devoted to clover and grain. The by-products of the potato fields and potato chipping plants are used as feed for the hogs, dairy and beef cattle that are also raised on the farm.

To coordinate and control activities on widely scattered sections of the farm, Mr. Meyer installed two-way radio communications, with the farm shop as the key dispatch center for the radio system. Other dispatch points are at each of two warehouses and the mobile units are in the farm maintenance truck, the three supervisors' cars and Dr. Weber's and Mr. Meyer's cars. A portable "Handie-Talkie" radiophone is also used.

Planting is started early in the spring to give the potatoes a longer growing season. Even though seed has to be trucked 20 to 25 miles from warehouse to fields after it is cut, planting takes place at an unusually fast rate. The supervisors inform the warehouse by means of two-way radio when they need more seed and manage to keep the work moving at a steady, even pace.

After planting in one field is finished, the supervisor checks with the farm manager, also by two-way radio, to find out if the next field is ready for planting, and can then move his men and equipment over. The warehouse is immediately radioed so that more truckloads of seed can be dispatched to the next field in time to prevent any work delay. Delays and complications which formerly resulted from sending load information back to the

warehouse by truck driver are entirely eliminated.

Small crews working in an isolated part of the farm without a supervisor are equipped with a "Handie-Talkie" unit in case they should need help or further instructions.

Probably the most dramatic use of the radio system occurs during September when the harvesting schedule calls for the entire crop to be harvested in this one month before the fall freeze starts. In this fight against time, harvesting must proceed at a minimum of thirty acres a day, and if bad weather should cause any delay, the lost time must be compensated for by increased harvesting speed. Fortunately radio has provided a means for maintaining such tight control over harvesting operations that the strain of getting the crop in on time has been greatly eased.

The potatoes are dug from the ground and left in windrows. Special harvesting machines then scoop up the potatoes and pour them into bulk, self-unloading trucks which have a capacity of six tons. Potatoes are then trucked to special, air-conditioned warehouses about 20 miles away and stored until needed.

The supervisors, using the two-way radio system for communications with the shop, the maintenance truck, and the warehouses, keep informed as new situations develop so that nothing gets out of hand. Often, when one of the harvesting machines is not functioning properly, the supervisor in charge of it can find out immediately what adjustments to make by means of radio. After it has rained in one area, the supervisor can use the radio to find out where it is dry enough to continue harvesting.

The versatility and speed possible with the radio system was demonstrated when a tractor-trailer truck loaded with 20 tons of potatoes broke down after it had left the Rhinelander warehouse bound for Madison. The driver radioed the office for help in moving the potatoes before they spoiled. The dispatcher relayed the call to Ray Miller, supervisor in charge of the potato operations, who was in one of the fields supervising the harvest. But there was no tractor available large enough to replace the one that was down.

Fortunately, Art Sorensen, warehouse foreman, who overheard the radio conversations, had the idea of sending several small trucks out to transfer the load. As the trucks came into the warehouse with a load of potatoes from the harvest, Sorensen rerouted them to the distressed trailer. Miller picked up a crew of men and drove them to the trailer and the dispatcher sent a small utility tractor with the idea that it might be able to pull the big trailer once its load had been lightened.

Within three hours, two-thirds of the load of potatoes had been transferred and taken back to the warehouse; the utility trailer had pulled the trailer back to Rhinelander and the rest of the potatoes were re-stored in the warehouse; and the tractor had then returned and pulled the down tractor back to the shop—all within the time it would have taken just to make arrangements without the radio system. In addition, when Mr. Schoeneck arrived at the down tractor, he determined exactly what parts were needed to get it back into operation and radioed the information back to the base station. The mechanic, in turn, located the parts and had them ready and waiting when the tractor was towed in for repairs.

Just such examples as this have convinced officials of Red Dot that radio is indispensable for their farm operation. It is valuable in giving farm supervisors the control they need to work efficiently, besides being an invaluable time and work saver.

This special machine which scoops up the potatoes from the windrows was developed only a few years ago for Red Dot.

Helical beam antenna directs signal out of the pocket formed by the taller surrounding structures.

Cities need not deny themselves the advantages of having two-way radio because they lack funds for purchasing a complete, integrated radio system outright. They can follow the example of the Pittsburgh Fire Department whose. . .

RADIO SYSTEM WORKS AS IT GROWS

Although it is true that complicated two-way radio systems must be thoroughly planned and integrated to obtain maximum benefits, it is possible to start off with the basic essentials of such a system and add to them without impairing effectiveness.

Take the case of the Pittsburgh (Pa.) Fire Department, which, partly because of the costly civic renovation program underway in Pittsburgh, was unable to purchase a complete two-way radio system outright. Instead, the system is being budgeted over a period of several years. As system components are added the department is successfully facing the problem of applying them with a minimum of confusion.

At dispatcher Ray Hazel's right are acknowledging station identification lights.

The radio system, with 20 mobile units or less than half of the planned equipment currently in operation, is already making a substantial contribution to departmental effectiveness.

The dispatcher operates from the fire department's communication room on the ninth and top floor of the City-County Building in downtown Pittsburgh. Complete coverage of the entire municipal area served by the fire department could not be obtained through an antenna atop the City-County Building because the taller structures surrounding it would interfere with signal propagation, so the base station is actually located at a high point on the ridge on the other side of the Monongahela River.

The three mile gap between the City-County Building and the station on the ridge is bridged by radio. A 450 mc. signal is beamed between the two points by helical beam antennas—highly efficient, directional antennas shaped like the barrel of a small, plugged up cannon. The actual antenna is wound around the barrel with pitch, length and diameter related to the frequency of operation. This design concentrates the lobe within a cone diverging at an angle of 45° from the vertex of the transmitting antenna.

At the ridge top station, the audio signal is abstracted from the 450 mc. carrier and is applied to a 150 mc. carrier for propagation over the entire Pittsburgh area.

A receiver permanently tuned to the system frequency is installed in every fire station in the city. When a call is made to a particular station, the fireman on watch depresses a button on the receiver to acknowledge the call.

Acknowledgement is made through a city-owned wire system. Because three fire stations share each wire line, Motorola Single Tone coding equipment is used to identify individual stations. When the fireman on watch depresses the button on the front panel of the receiver, he causes the Single Tone transmitter to generate its specific frequency. The signal passes down the line to a bank of three decoders at the central station. The one decoder of the three which is tuned to the proper frequency

operates a relay, which, in turn, lights the lamp associated with the acknowledging station. A battery of these lamps, one representing every fire station in the city, is mounted on a panel on the dispatcher's desk. Once the lamp identified with the addressed station is lit, the dispatcher completes his transmission.

Once every hour, the dispatcher calls for acknowledgements from all stations as a system check. If every lamp on the panel lights up, the dispatcher knows that the entire system between the dispatch points and the stations is functioning properly.

The Single Tone equipment is engineered so that false triggering by noise—long the nemesis of unit tone coding apparatus—is next to impossible. The decoder incorporates a differential selectivity circuit which electrically compares voltage magnitude at the frequency to which the decoder is tuned with the voltage of other frequencies on the line. A tone generated at the transmitting station is of sufficient magnitude to overbalance all the noise on the line. However, when only noise is present, the noise at the tuned frequency is invariably less than the sum of the voltages at other frequencies.

Two-way radio units are also installed in all the chiefs' cars so that every chief can communicate fully with the dispatcher while out of the station. Next to the radio remote-control console on the dispatcher's desk is a small box with two rows of lights, one red and one white, and a row of three-way switches across the front. Each group of two lights and one switch, one from each row, represents a particular chief. When the switch is turned so that neither light is on, the chief is in the station. If the white light is on, the chief is in his car. If the red light is lit, he is at a fire.

Also, two-way radio units are installed in all the squad wagons operated by the department. These wagons carry firemen to a fire when additional men without additional apparatus are required.

Once at the scene of the fire, the chief retains the ability to communicate with the dispatcher, an ability that is often invaluable. If a fire threatens to get out of hand, it takes only a second to summon help.

To further insure cooperation between firemen and to increase their safety, the department provides six "Handie-Talkie" radiophones and one "Handie-Talkie" radiophone pack. These portable units are carried into burning buildings or other potentially dangerous situations where the firemen are likely to be out of signaling or calling range. With these radios, the men can call for help, for more pressure in the fire hoses or for additional equipment. From the other end, the chief can call the men out of dangerous situations visible to him but not to them.

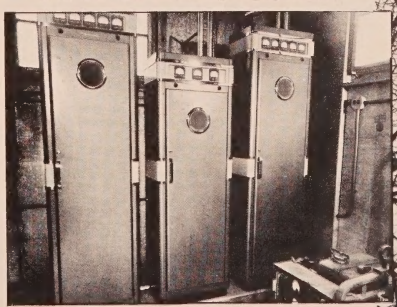
The fire department's radio system is purchased and maintained through the Pittsburgh Police Department to save the expense of setting up duplicate facilities. The police department also shares the equipment building and antenna tower on top of the ridge. The higher efficiency so obtained frees more money for investment in more radio equipment for both departments.

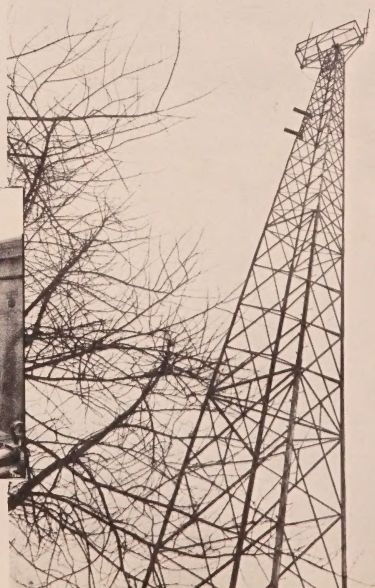
Six men in squad wagon about to leave for a fire. Mobile unit can be seen mounted on the front wall above the fan.

The man who profits from all this planning, of course, is the Pittsburgh citizen who sleeps safer as the system matures. Because the men who do the planning, Superintendent John Kilgallen of the Bureau of Electricity, Chief Radio Engineer William Gamble, Director of Public Safety George E. A. Fairley and Asst. Superintendent in charge of communication F. J. Schafer, are men of foresight and imagination, the system is passing through one well conceived phase after another. Eventually, the fire department will have as good a communications system as any city in the nation, a system properly associated with the city whose name is rapidly becoming synonymous with progress.

Helical antennas mounted halfway up the base station tower are directed toward the City-County Building. At the tower top are the police department and the fire department antennas.

The 150 mc. base station and standby base station (tall units) are located at the base of the antenna tower along with the 450 mc. relay equipment.





One leg of the Lafourche Telephone Company microwave system crosses Caminada Bay.

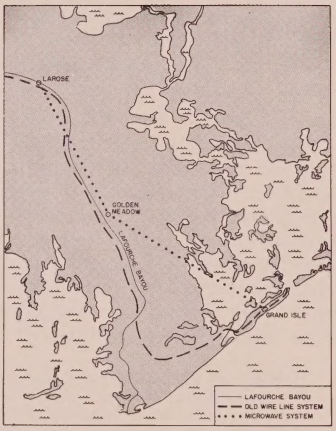
Central Station at Larose, Louisiana beams signal 17 miles to Golden Meadow relay station.

Microwave Spans Bay, Bayou and Swamp

Euclid used to say that a straight line uses the least wire, or words to that effect, but it wasn't until just recently that the Lafourche Telephone Company of Golden Meadow, Louisiana, put up a line so straight that it required no wire at all. The new line is a two-span multi-channel microwave system that leaps some of the worst terrain a pole line ever had to go around.

The Lafourche Telephone Company system roughly parallels the Lafourche Bayou for its last 60 miles before it drains into the Gulf of Mexico. The phone system extends a bit beyond the bayou across Caminada Bay to serve 150 subscribers on an island in the gulf called Grand Isle.

Up until February, 1952, a portion of these 150 subscribers were provided telephone service through five carrier circuits on a two-wire line extending from the central office at Larose, La., out to the Island. The wire line wandered a bit to skirt the swamps in its path and then took



a big jog to follow the bridge across the bay.

Along all its meandering length the wire line was subject to the depredations of man and nature. The salt water atmosphere ate into it. Occasionally, high winds and storms ripped it in two. And once in a while fishermen, boats, or low flying pelicans broke through a section and to repair the damage, the linemen often had to slog through swampland to reach the break.

Grand Isle telephone requirements gradually increased until they exceeded the capacity of the five channel system. To meet the new demand, the company decided to replace rather than expand the existing system.

Microwave seemed to be more dependable and easier to service, and certainly provided more room for future expansion. A year of experience with a microwave system designed by Motorola Inc. has since substantiated these impressions.

24 CHANNELS

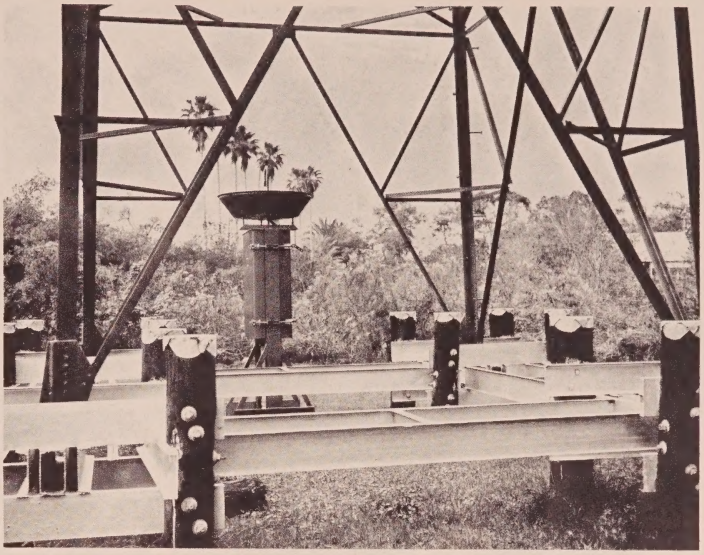
The microwave system extends seventeen miles from the central telephone office at Larose to Golden Meadow, La., and seventeen miles from Golden Meadow to Grand Isle. Only eight of the potential twenty-four channels are in use at present, and all eight extend the length of the system. No signals are dropped out or inserted at Golden Meadow. Of these eight channels, seven are toll circuits and one is leased directly to the Humble Oil Company.

At Grand Isle, the microwave system is tied into an unattended community dial station which provides service for 150 telephones on 100 lines. Very soon, 100 more lines and three more microwave channels are to be added.

Maintenance has been considerably simplified by the new arrangement. All the equipment is concentrated in the three stations and no trouble can possibly develop between them. All three stations are located right off a well traveled road. These conditions are in sharp contrast with those of pre-microwave days when the wire line could develop a defect anywhere between Larose and Grand Isle without regard for the convenience of the service man. This last consideration is of importance because some of the country over which the line was strung was not too accessible even in the best of weather.

CONTINUOUS SERVICE

In the microwave system, the channel subcarriers are frequency modulated by the individual voice signals. Then, the subcarriers are combined and the microwave carrier is frequency modulated by the combination. To increase the inherent dependability of this system, standby power units and standby microwave RF circuits are provided at each station. If the local commercial power fails, the standby natural gas and/or butane generators kick on automatically to supply operating power until commercial power is again available. If the RF carrier circuit should fail at one of the stations, the standby circuit is automatically switched into operation. The switchover is indicated at the Larose station so the fault can be repaired. No standby subcarrier equipment is required since failure of the circuits is rare. In the event of a channel fault, traffic is simply re-routed over an alternate channel until the out-of-service channel is back in operation. Consequently, from the subscriber's point of view, the service is continuous.



Piles driven into the spongy ground provide a solid support for the microwave tower.

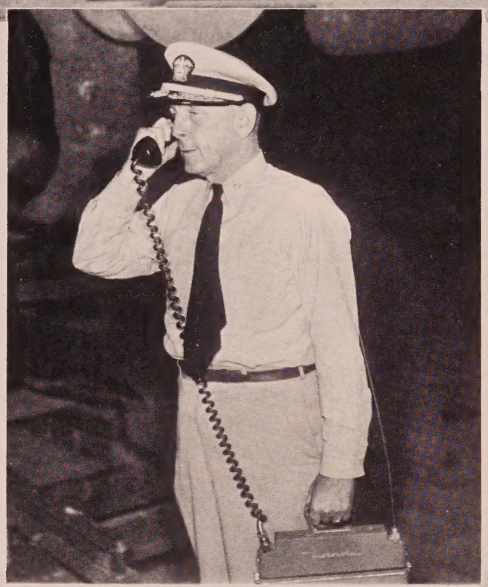
Expansion in the future will require little additional equipment. To add a channel only a subcarrier transmitter, a subcarrier receiver and a voice terminal are installed at each of the two terminal stations. In each channel the voice terminal is placed between the subcarrier transmitter and the subcarrier receiver on one side and the dial switchboard on the other, so that from the switchboard the microwave channel looks like the conventional two wire dry line. This process can be repeated until twenty-four channels are in operation.

A full year of operation has demonstrated that microwave cannot tell the difference between good weather and bad, swampland and prairie, storm and calm, or bay and beach. The system carries its messages day in and day out through all conditions.

Eight microwave channels are terminated at this Larose, Louisiana central switchboard.

The U-505 on a floating dry dock, being turned to prepare it for beaching.

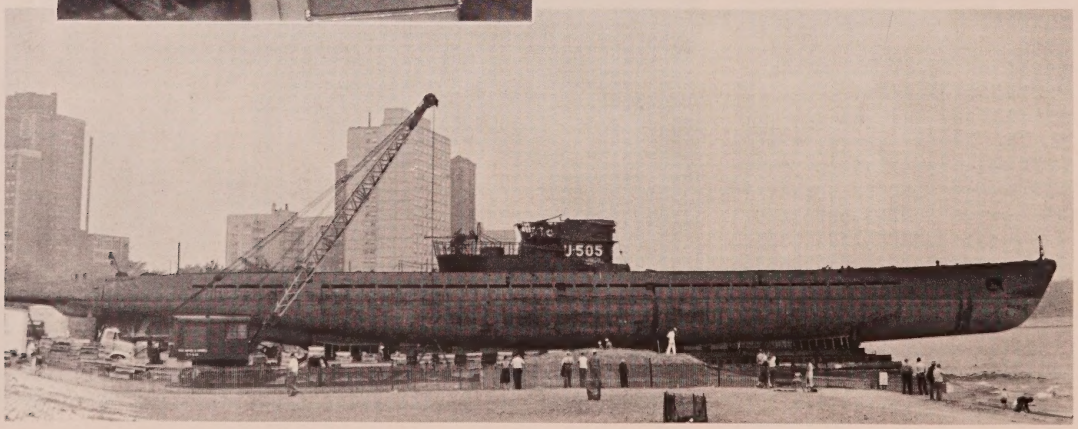
WAR TROPHY



RIGHT: Looking aft from the conning tower of the U-505 across South Shore Drive toward its permanent resting place, the Museum of Science and Industry.

LEFT: Rear Admiral Daniel G. Gallery who commanded the task group that captured the U-505, demonstrates a Motorola "Handie-Talkie" portable radiophone which was used for coordinating the critical move from dry dock to land.

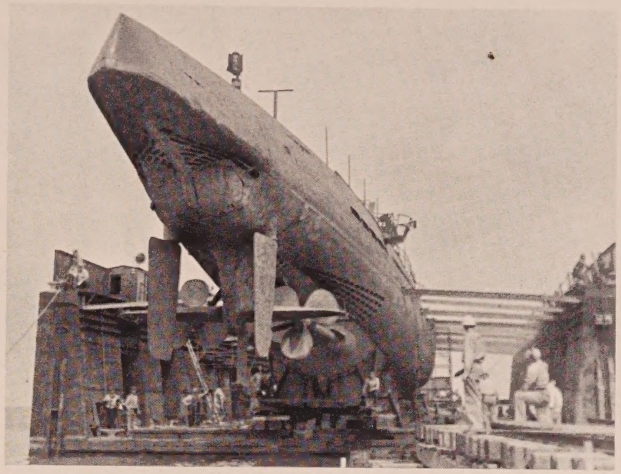
BELOW: View of the beached U-505 dramatically shows its tremendous size.



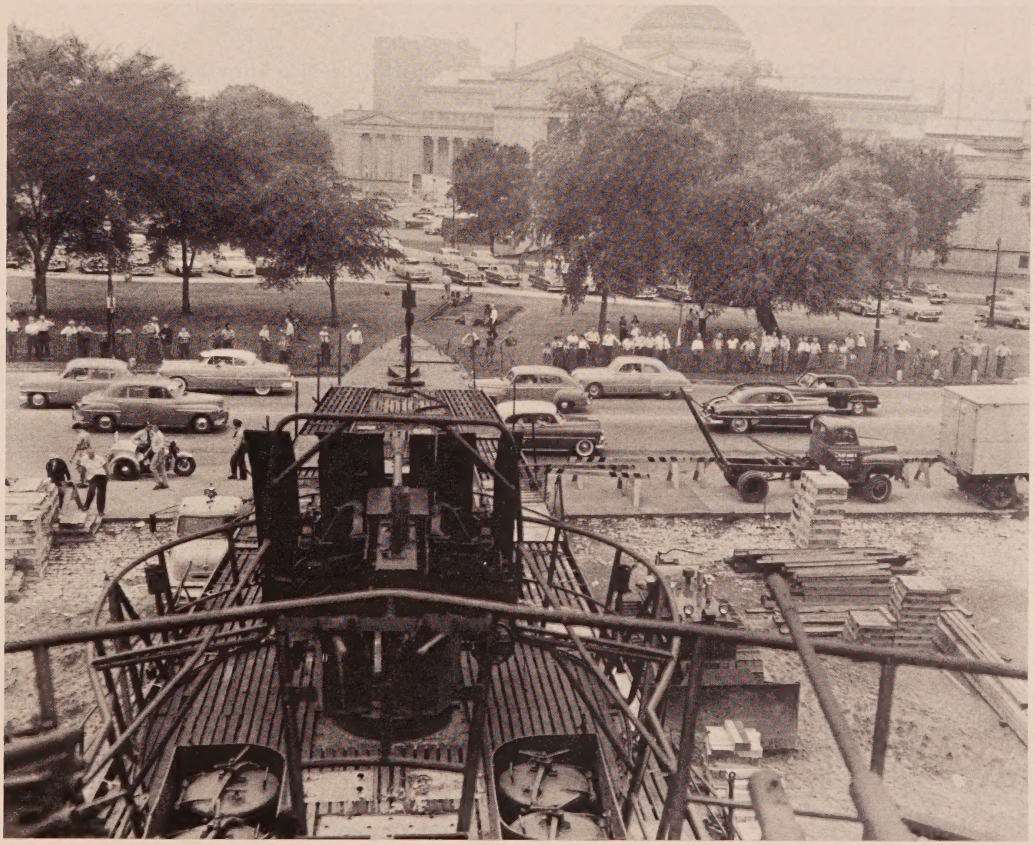
NOW MUSEUM PIECE

The U-505, a German U-Boat captured off the coast of French West Africa near the end of World War II, has made its final journey. Ten years after its historic capture by the U. S. Navy, the Nazi submarine has finally dropped anchor at Chicago's Museum of Science and Industry. Here it will be a permanent outdoor exhibit and will be viewed by thousands of people who visit the Museum annually.

Because of its tremendous size—almost 1000 tons—moving the U-505 from Lake Michigan across Chicago's South Shore Drive to the Museum was a tremendous engineering undertaking. Here are some pictures showing the mammoth sub being lifted out of the lake.



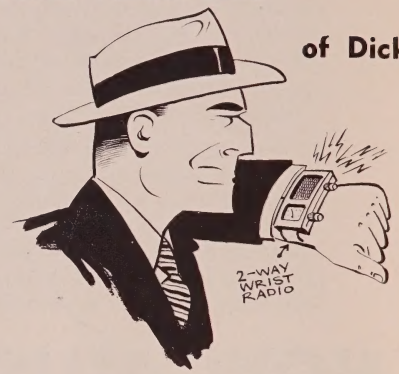
The U-505 on the floating dry dock making contact with the special pier built out from the beach.



NEW USES for M

Washington Police Chief Murray talks to officers directing traffic on busy capital streets during long American Legion parade.

Police Follow Lead of Dick Tra



Courtesy Chicago Tribune

Left: Detective Sgt. Vincent O'Hara tests battery-powered two-way radio in St. Louis. Strap on left wrist holds mike. Earpiece is speaker.

Below: Police Chief Leo Brooker tries out newest "mobile" in Lakeland, Fla., Police Department. Strap secures portable in basket.

America's police officers have come up with some novel uses for radio recently in their continuing battle against crime and disorder.

Experiments are going forward in St. Louis on a close kin to Dick Tracy's wrist radio. Using miniaturized transmitters and receivers developed by Motorola, the Missouri technicians have produced tiny battery-powered two-way radios which enable patrolmen to receive calls and report directly to headquarters. The microphone is worn like a wristwatch, and the receiver is connected to a hearing-aid type earphone.

Night patrolmen walking downtown beats in Manteca, Cal., now carry "Handie-Micro-Talkie" transmitters, enabling them to call headquarters if help should be needed. Chief Vernon Jefferies terms the one-way sets "entirely practical for this type of police work."

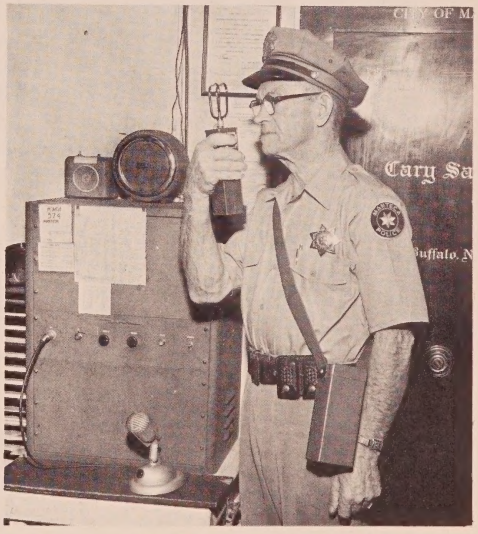
In Lakeland, Fla., the newest weapon against thievery is the radio-equipped bicycle. Police Chief Leo Brooker has set his beat men up with bikes and "Handie-Talkie" portable radiophones. "An officer can cover his beat silently, effectively and more quickly on a bicycle. With radio, he can report to headquarters or summon the nearest patrol car if he needs assistance in a hurry," Brooker declares.

MINIATURES

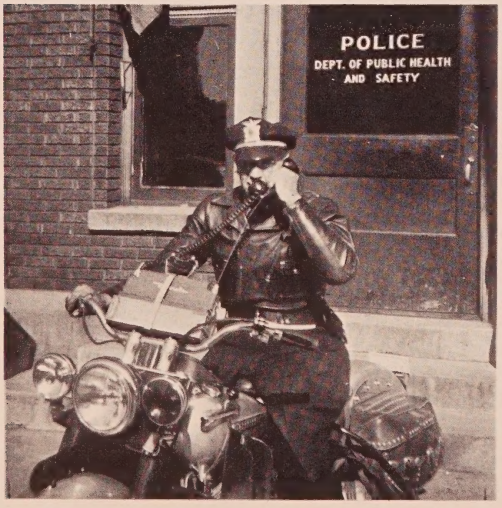
Tracy

Helicopter piloted by J. C. Weadock of Bell Aircraft Corp. hovers above terrace of Municipal Building in Washington, D. C. Chief Murray, left, operated radio packset.

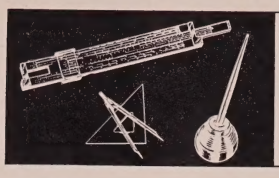
In the nation's capital, Chief Murray of the District of Columbia Metropolitan Police Department went aloft in a helicopter to supervise traffic during the recent parade and national convention of the American Legion. Murray used a "Handie-Talkie" packset to communicate with officers below.



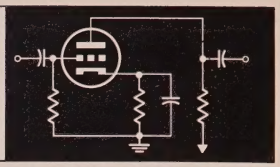
Manteca Patrolman Henry Hubbart tests new "Handie-Micro-Talkie" portable transmitter. Unit weighs 31 ounces with batteries.



Left: For temporary usage, some police departments have strapped "Handie-Talkie" radiophones to handlebars of motorcycles.



Technical Notes Section



FCC LICENSING

The Federal Communications Commission was created by Congress, "for the purpose of regulating interstate and foreign commerce in communication by wire and radio so as to make available, so far as possible, to all the people of the United States a rapid, efficient, nation-wide and world-wide wire and radio communication service with adequate facilities at reasonable charges, for the purpose of the national defense, for the purpose of promoting safety of life and property through the use of wire and radio communication—".

All devices which radiate electromagnetic energy come under the jurisdiction of the FCC. Because there is inadequate space in the radio spectrum to permit unlimited use by all interested parties, restrictions are placed on who may use the radio spectrum and how it may be used.

The FCC works closely with both users and manufacturers in establishment of new rules. Rules changes to meet changing conditions are made on the same basis. If conflicts exist in recommendations, the FCC holds hearings to resolve any controversy and arrive at regulations which best fit the precept "in the public interest, convenience and necessity".

USERS

For administrative purposes, the FCC categorizes users into three major groupings; the broadcast services (AM, FM, TV and auxiliary), the common carrier services (communications service for hire) and the safety and special radio services (all other users). Of these three, the last contains the largest number of individual licensees and includes the major user groups listed in Table I.

It is impossible to cover all facets of the FCC rules in such a short summary as Table I. Therefore, for specific details and complete information for any of the services, it is suggested that the appropriate part of the rules be consulted. These publications are available from the Supt. of Documents, U. S. Government Printing Office, Washington, D. C., for a nominal charge. Local FCC offices throughout the U. S. and its possessions can provide further details if required.

For clarification, although virtually all of the safety and special radio services are listed, Motorola does not attempt to manufacture all types of equipment on all frequencies for all users. Although Motorola does not manufacture airborne radio equipment on the aviation frequencies, Motorola mobile equipment operating on other frequencies, e.g. police and industrial, is used in aircraft. Similarly, although Motorola does not manufacture equipment specifically designed for amateur use, it is modified for use by "hams" in certain instances.

FREQUENCIES

The frequencies available for the various services appear throughout the frequency spectrum. The frequency used for a specific application depends on the requirements for that application and the frequency available in the area. The FCC does not grant exclusive rights to any frequency to any licensee in these services. The license merely grants permission to make use of the frequency. Although the FCC attempts to grant licenses to minimize interference, it cannot and will not guarantee complete freedom from all types of interference.

COMMITTEES

The most potent force for optimum use of the radio spectrum among the user groups is the frequency coordinating committee plan. An organization of all interested radio users within the service group, the committee makes a single unified recommendation to the FCC when required and coordinates the activities of all members to insure best use of radio facilities. In most cases, the FCC requires a coordinating committee clearance before granting a frequency.

It thus behooves the individual radio user to support his coordinating committee to protect his interests in the radio spectrum and to insure that the rules changes or new rules adopted by the FCC will be practical and reasonable from his viewpoint.

APPLICATIONS

For operation under Parts 10, 11 or 16 of the FCC rules, application is made on FCC form 400. A construction permit is the first grant, authorizing the licensee to install and make preliminary tests of the equipment. An application for a license is then made on the same form. In many cases the FCC is currently granting the construction permit and license on the same form simultaneously in the well established services. The license term is one to five years, depending upon the most convenient renewal date. The renewal is good for four years. Developmental authorizations (above 220 mc. and for services not established on a regular basis) are limited to a maximum of one year before renewal is required.

Marine radio applications are made on FCC form 401 and 501-A. License terms are the same as those in the preceding paragraph. Marine radio equipment is required to have FCC Maritime Type Acceptance. The manufacturer obtains type acceptance by submitting complete test data and equipment information to the FCC for approval.

Application for a citizens radio station license is made on FCC form 505 to the local FCC office rather than to the Washington, D. C. office. The license term is five years. Type approved equipment is that which is considered acceptable for use in this service without further qualifications or applications. Type approval is obtained by the manufacturer by submitting sample equipment to the FCC for complete testing.

USE

Since there is limited spectrum space available, any service which successfully demonstrates a need for frequencies is expected to use those frequencies. Any service which is granted frequencies then does not employ them may be required to explain why the frequencies should not be reassigned to other users or at least shared with other services.

Similarly, any service which allows the licensing and operation of its radio systems to pass out of its hands could conceivably, in time, have its frequencies allocated to the agency which actually employs them. This thought was recently expressed in a public statement by an FCC official.

The FCC also maintains field engineering offices which monitor the various channels and inspect equipment periodically, to insure that all users are operating within regulations.

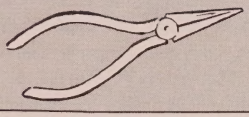
Information Bulletin No. 11, dated March 1954, is available directly from the FCC and contains further information on this same subject.

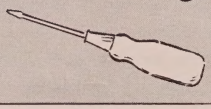
TABLE I

SAFETY AND SPECIAL RADIO SERVICES *(abbreviated)*

SERVICE	ELIGIBILITY	FCC RULES
AVIATION	All commercial and private aircraft and ground stations	Part 9
AMATEUR	Non-commercial hobbyists and experimenters	Part 12
CITIZENS	All citizens not otherwise eligible for other licenses	Part 19
EXPERIMENTAL	Commercial research and development	Part 5
INDUSTRIAL	Business enterprises	Part 11
Power	Electric, gas, steam and water public utilities	
Petroleum	Petroleum product prospectors, producers, refiners and pipeline operators	
Forest Prod.	Timber and logging companies	
Relay Press	News services and newspapers	
Motion Picture	Motion picture studios	
Low Power	Any business enterprise	
Special	Any manufacturing, construction or production activity in a rural area (including farming) or in an urban area within limitations	
LAND TRANSPORTATION	Common and contract carriers of passengers and freight	Part 16
Railroad	Railroad operating companies	
Taxicab	Taxicab operators	
Motor Carrier	Inter-city busses and urban transit	
Highway Truck	Inter-city or "over-the-road" trucks	
Auto Emerg.	Public garages and auto clubs	
MARINE	All commercial and private land stations for maritime communications	Part 7
	All marine-utility (portable) stations on land or shipboard	Part 7
	All commercial and private radio equipped vessels	Part 8
PUBLIC SAFETY	Agencies protecting life and property	Part 10
Police	Municipal, county and state police	
Fire	Municipal and volunteer fire dept's.	
Forestry-Conservation	Governmental and private forest protection	
Highway Maint.	Governmental operation, supervision and maintenance of public roads	
Special	Disaster relief organizations	
Emergency	Physicians and veterinarians in rural areas	
	Ambulances and rescue squads	
	Communications common carrier standby	
	Isolated area communications	
	Communications common carrier emergency repair	

SERVICE HINTS and SHOP NOTES





RF WATTMETER

RF wattmeters, like other alternating current indicating devices, are susceptible to the same meter movement errors as DC instruments but, in addition, are susceptible to additional error introducing effects. Impedance changes, temperature effects and aging of the detector can all lead to inaccuracies. While, in general, a good RF wattmeter is reasonably accurate, it should not be depended upon for exact readings unless it is calibrated frequently.

6BG7

The type 6BG7 dual triode vacuum tube used in some earlier Motorola transmitters and receivers is no longer being produced by tube manufacturers. Hence, it is no longer used in current production. For replacement, several alternatives are available.

The Motorola Parts Department acquired a large stock of 6BG7's at the time they were discontinued. The stock is adequate to care for normal demand for some time to come.

The 6BG7 can also be replaced with a 6BF7 which has identical electrical characteristics. The 6BG7 has short leads (for plugging the tube into a socket) while the 6BF7 has long leads (for wiring the tube into a circuit). Thus, by clipping the leads of a 6BF7 to a shorter length, it becomes a 6BG7.

The 6BF7W is a "high reliability" version of the 6BF7 and like the 6BF7 can be converted to use as a 6BG7 by clipping the leads.

MILITARY MIC.

If, for any reason, a military type microphone is dis-assembled, it must be properly re-assembled for correct operation. Specifically, the push-to-talk button is designed with a keyway or groove on one side which mates with a key or boss on the microphone housing. If the button is reversed in the re-assembly process, the reversed keyway may cause the button to stick and interfere with normal push-to-talk operation.

IMPEDANCE

Motorola receivers are designed for operation from a 50-70 ohm antenna circuit. In base station installations where multiple receivers are operated from the same antenna without impedance compensation, in certain installations where tuned cavities are employed or where the antenna and transmission line are not matched to the receiver, improper impedance match is presented to the receiver antenna circuit.

Specifically, the high sensitivity of Motorola 25-50 mc. Sensicon receivers is achieved through use of a 6AK5 RF amplifier, a tube with comparatively high grid-to-plate capacitance. If the grid circuit of the 6AK5 is not sufficiently loaded, through severe impedance mismatch, the RF stage can act as a tuned-plate, tuned-grid oscillator. The symptom is receiver quieting with the squelch "off" and no receiver input signal. This may be checked by removing the first RF tube to ascertain if the receiver output under no signal conditions returns to normal noise output. If this situation is encountered, the 6AK5 tube can be replaced with a 6BH6 tube. There is no change in wiring required. Use of the 6BH6 will reduce receiver sensitivity by approximately .05 microvolts which is inconsequential in most applications and will simultaneously minimize any tendency toward oscillation because of impedance mismatch.

ANTENNA TERMINALS

Antennas designed with hermetic seal end terminals and air dielectric transmission line end terminals require care in connection to transmission lines. Adequate clearance must be provided for the center conductor splice pin. If the center conductor of the line is cut too long, the splice pin will force the center conductor of the end seal inward as the connection is tightened. In a flange type connection, sufficient pressure can be exerted to fracture the end seal as the joint is drawn up tight.

A fractured end seal may then permit loss of line pressure and can lead to deterioration of line performance through moisture entering the line.

Care in cutting the transmission line center conductor short enough to provide room for the splice pin will avoid this type of problem. A check at ground level will avoid difficulties at the tower top.

MOTORCYCLE

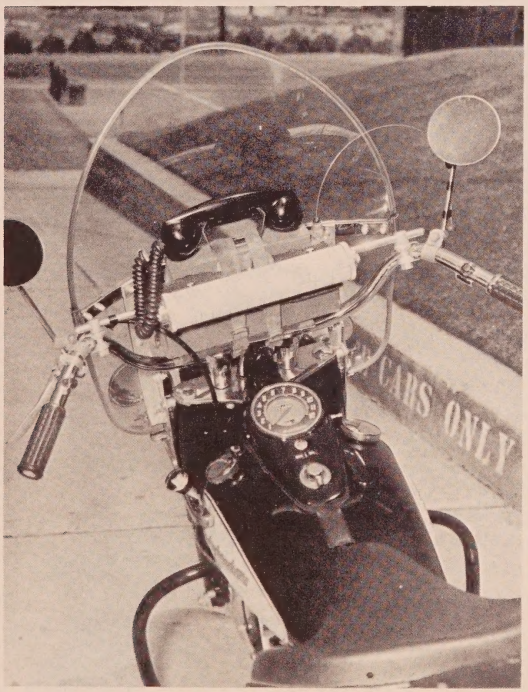
Milton Ravich of Los Angeles reports a unique solution to a police communications problem.

When a new Harley Davidson motorcycle arrived at the City of Manhattan Beach ahead of its radio equipment, Senior Motorcycle Officer Robert Carstens had transportation but no communications. Officer Carstens, however, evolved a temporary solution to the problem.

A police "Handie-Talkie" radiophone was securely strapped to the handlebars. The antenna was fastened to the rear view mirror with insulating tape, avoiding any annoyance to the rider. Even though the "Handie-Talkie" unit is not designed for nor recommended for this type of application, it served its purpose admirably. While Officer Carstens could not listen for calls while he was in motion, he did call in periodically for assignments that would otherwise have required handling by the regular prowl cars.

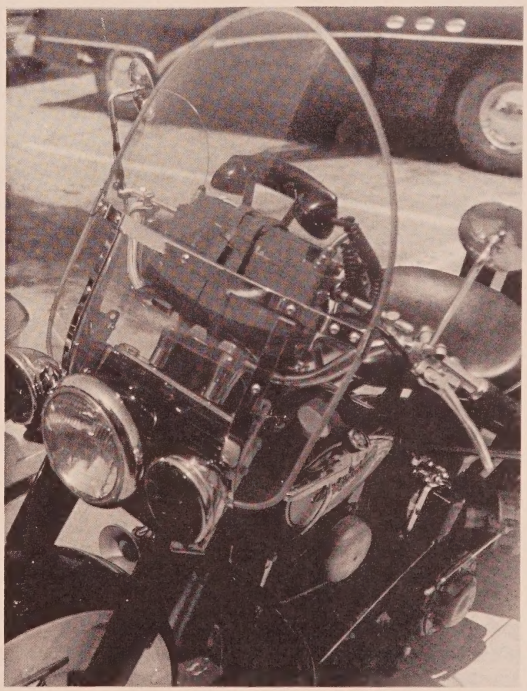
450 MC RECEIVER

If the instruction manual procedure for 450-470 MC. receiver alignment is not followed, it is possible to make an error which results in degraded gain and receiver sensitivity. The possibility of error lies in alignment of the second mixer coil using the wrong test meter position. The second mixer coil, L14 (382) in early models and L5 (382) in current models, should always be adjusted for peak reading in meter position 1 or 2. Adjusting for a peak in position 7 or 8 (—4 or 5 when a K-9326 adapter is used) will result in improper division of energy between the second mixer coil and the multiplier stages which feed the first mixer. A slight dip in position 7 or 8 will actually be coincident with the peak adjustment of position 1 or 2 when the alignment is properly accomplished.



———a temporary solution to the problem of providing radio communications for a motorcycle prior to installation of a standard motorcycle radio unit.

Manhattan Beach, California, Police Department adaptation of a "Handie-Talkie" radiophone for motorcycle use———



6/12 VOLT OPERATION

A description of the power circuits used in the Motorola "true" 6/12 volt mobile two-way radio equipment (patent applied for).

The design of "true" 6/12 volt mobile radio is based on two precepts. Firstly, a mobile radio set is periodically removed from one vehicle and replaced in another, generally when the vehicle is out of service or when the radio set is placed in the service shop. By using a single radio set for both 6 and 12 volt operation, without changes, any conversion costs are eliminated and there is no possibility of radio set damage through connection to improper voltage. Secondly, since the radio power cable is generally permanently installed in a vehicle and removed only when the vehicle is replaced, any required adaptations between 6 volt and 12 volt operation can be accomplished in the cable. Of course, a 6 volt cable can be easily converted to 12 volt operation, if necessary.

CIRCUITS

The simplified diagram illustrates the principles of this Motorola development as applied to the power circuits of the Motorola 6/12 volt mobile radio set. Differences between this and conventional single-voltage power circuits are easily distinguished. The high voltage transformer has two primary windings. The vibrator, developed especially for Motorola, has two electrically isolated but mechanically linked reeds. The filament circuit (including relays, heaters and pilot bulbs) is arranged in a three-terminal series-parallel configuration.

OPERATION

For 6 volt operation, at the instant that the vibrator reed closes the upper contacts, the 6 volts applied to pin 1 of the power plug produces a current flowing through the center tap of the upper primary winding on the transformer, upward through the winding, through the upper vibrator contacts and reed to ground at pin 2. Simultaneously, current flows from pin 3 through the upper half of the second primary winding, through the second vibrator reed to ground. The flux lines produced by the two primary windings are additive and since the two vibrator reeds operate in unison, are always in phase. During the other half cycle, current flow is, of course, through the lower halves of the primary windings.

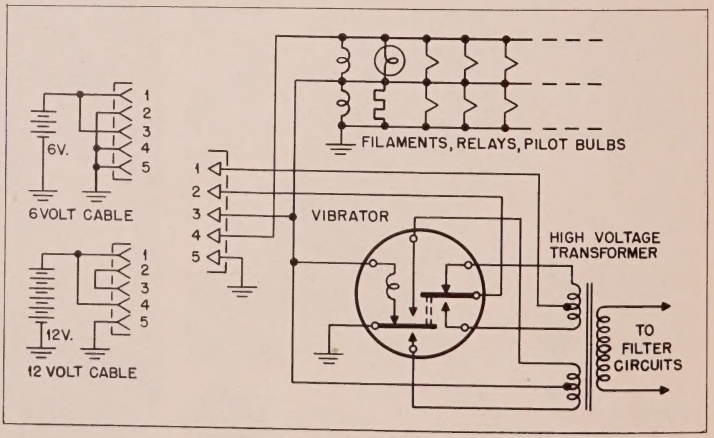
For 12 volt operation, under the instantaneous condition discussed previously, the current flow is identical to that for 6 volt operation. However, instead of pin 2 being grounded, and primary voltage applied to pin 3, the two are tied together, placing the two primary sections in series, each operating at 6 volts. Since the primary currents and ampere-turns are identical in both cases, the secondary voltage is also identical.

The interconnection between the two primaries is used as a 6 volt tie point. Because the two windings are on a common core with common flux and with an equal number of turns, the same voltage must appear across both windings because of auto-transformer action. This action maintains the tie point voltage at exactly one-half (6 volts) of the input voltage (12 volts). By equalizing the voltages, the autotransformer action provides any current required to keep proper filament voltage without using power-robbing dropping resistors even if a filament circuit unbalance exists.

The filament circuit connections place all 6 volt circuits in parallel for 6 volt operation but provide two parallel 6 volt sections in series for 12 volt operation.

By placing the vibrator contacts in parallel for high current (6 volt) operation but in series for high voltage (12 volt) operation, vibrator life is lengthened.

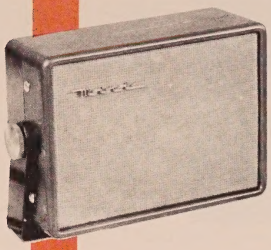
Once again, Motorola engineering has contributed a significant technical advance to the field of communications, an advance already proven by nearly a year and a half of service to Motorola customers.



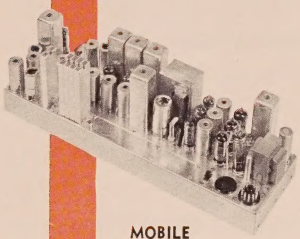
Simplified partial diagram of 6/12 volt power circuits.

NEW PRODUCTS

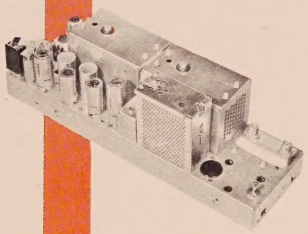
450-470 MC. TWO-WAY RADIO EQUIPMENT



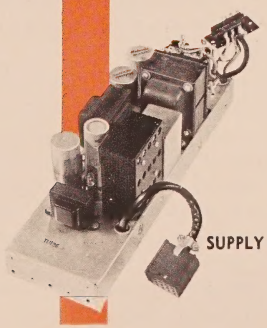
MOBILE SPEAKER



MOBILE RECEIVER CHASSIS



MOBILE TRANSMITTER CHASSIS



MOBILE POWER SUPPLY CHASSIS

Incorporating the latest achievements in UHF circuitry and techniques plus other technical advances, current Motorola 450-470 mc. two-way radio units represent the best in radio equipment for the Land-Mobile Services (450-460 mc.) and the Class A Citizens Radio Service (460-462 and 468-470 mc.).

RECEIVERS

The mobile receiver incorporates a multiple tuned cavity preselector of new design, employing rectangular rather than cylindrical cavities. With these new cavities, performance is improved over that of previous models even though RF amplifier tubes are no longer used. Additional protection against strong signals of UHF TV stations is provided.

The base station receiver includes greater selectivity (—85 db. at ±35 kc.) than previous models and all models provide improved automatic frequency control operation.

The audio output of all receivers has been increased to more than 1.5 watts to a 3 ohm speaker. The audio response of the receivers has been improved to follow the 6 db. per octave reference more closely (down less than 3 db. at 300 and 3000 cps.).

Another improvement is the inclusion of the TU215 inverted cone speaker as a standard accessory. Better frequency response, larger cone area and improved intelligibility are the primary features.

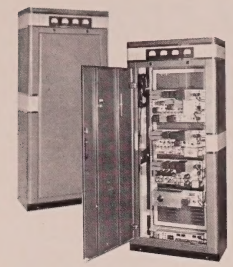
TRANSMITTER

Simplified tuning of the final and driver cavities and a new harmonic filter at the transmitter output are included in the transmitter improvements. Greater driving power to the UHF stages assures addition safety margin to provide longer useable tube life.

Although improvements have been added to all the chassis, the housing remains unchanged. Similarly, the power input connections are identical to those of earlier 6/12 volt 450-470 mc. mobile units. Thus, the newer radio sets can be added to existing systems and interchanged with the earlier models in the various vehicles in the fleet.

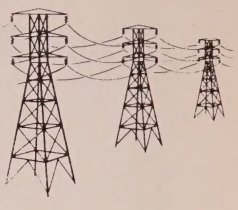
TYPE APPROVAL

After extensive tests in the FCC laboratories, Citizens Radio Type Approval has been granted these current Motorola models. Type Approval Number CR416 has been assigned to mobile models and Type Approval Number CR417 has been assigned to all base stations, desk-top console, upright indoor cabinet and weatherproof cabinet models.



POWER LINE CARRIER EQUIPMENT

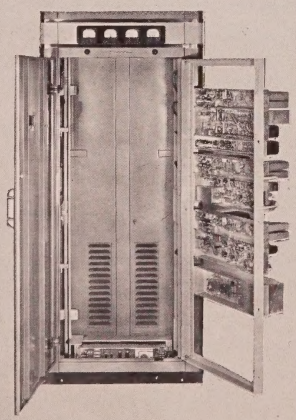
"radio over wire" with an immense capacity for communication



Power line carrier is an RF signal (50-200 kc.) which is coupled to an electric power transmission line to provide a communications channel over the power line. Several communications channels (each on an RF carrier of a different frequency) can be transmitted simultaneously over one power line in this manner.

Power line carrier is, effectively, "radio over wire". However, since the RF energy is almost entirely confined to the wires, no license is required from the Federal Communications Commission. Power line carrier utilizes all the modern developments and advanced techniques of radio.

Standard power line carrier terminals are available in a 68" high fixed-rack cabinet, 72" & 90" high swinging-rack cabinets, and a 68" high open rack. Other mountings available as desired.



SWINGING-RACK CABINET

MOTOROLA EQUIPMENT

Motorola power line carrier equipment provides a high quality audio channel. In early 1950, Motorola introduced the first commercially available *crystal-controlled high-selectivity* power line carrier equipment. Extremely close carrier channel spacing was achieved by employing advanced narrow-band FM radio techniques to obtain:

1. low transmitter spurious and harmonic output
2. automatic modulation control
3. high receiver selectivity before amplification
4. improved performance at lower transmitter output

Superiority of this design established a new standard in the industry. Extensive application in the field has "job-proven" Motorola power line carrier equipment as a means of dependable and high-quality communication.

SPEECH-PLUS OPERATION

Frequency-shift VF carrier (for teleprinting, telemetering, protective relaying, load control, etc.) and supervisory control signals can be transmitted simultaneously with voice over the same Motorola power line carrier channel. For example, a Motorola duplex power line carrier channel provides a high quality duplex audio channel which can transmit *simultaneously:* a voice (telephone) circuit, up to five frequency-shift VF carrier signals, and supervisory control signals for up to 90 points.

This immense capacity for communication is available over existing power lines to meet the growing requirement of the electric power industry in operating complex generation, distribution, and transmission systems.

OPERATION

There are three types of Motorola power line carrier equipment, each for a specific type of operation: (1) manual simplex, (2) automatic simplex, and (3) duplex.

SIMPLEX OPERATION

Simplex operation means that communication over the transmission path can occur in only one direction at a time. This type of operation permits an unlimited number of power line carrier stations on a "party line" circuit with only a *single* power line carrier frequency. Coded ringing can be used for selective calling. Since the carrier frequency spectrum is becoming increasingly crowded, especially on large interconnected systems, simplex operation is advantageous except when the exclusive applications of simultaneous two-way (duplex) operation justify the use of two carrier frequencies.

The impedance and attenuation characteristics of the telephone line are not as critical in a simplex system as in a duplex system. The full gain of the transmitting and receiving amplifiers can be used to overcome excessive line attenuation since no hybrid coils are used and it is not necessary to balance line impedances with artificial

networks. Also, simplex operation is convenient in noisy locations such as generator stations since transmissions occur only when the operator is talking, eliminating local noise from the telephone line while receiving.

manual simplex

Manual simplex operation is the manual control of the transmitter and receiver by the operator as he talks or listens, i.e., he turns the transmitter "on" and the receiver "off" when talking and vice versa when listening. Telephone termination equipment (in the power line carrier terminal) for manual simplex operation is simple and inexpensive. Remote telephone extensions are served over a two wire line which carries both the AC voice and ringing signals and the DC control current. The length of the telephone line is determined by the DC loop resistance rather than the audio attenuation. Since a telephone (or microphone) with a pushbutton is used, manual simplex operation is often referred to as "push-to-talk" operation.

Application of manual simplex power line carrier equipment is confined almost entirely to private "party line" voice communications. It cannot be readily incorporated into private branch exchanges or public telephone circuits since they are not designed to provide continuity of the transmitter DC control circuit.

automatic simplex

Automatic simplex operation, of course, means that the transmitter and receiver are controlled automatically. A voice-operated control unit switches the transmitter "on" and the receiver "off" during outgoing speech and vice versa during incoming speech. This control unit operates so quickly and quietly that an automatic simplex circuit can hardly be distinquished from a well-balanced duplex circuit.

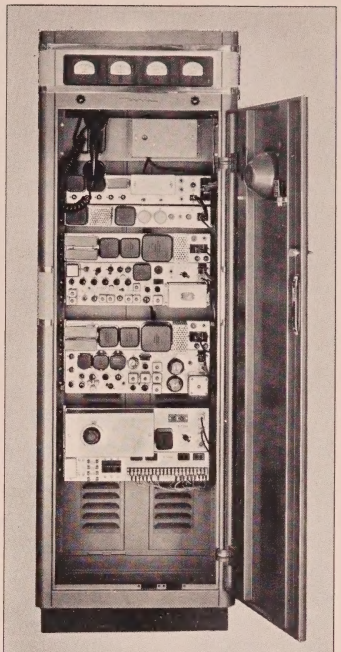
Since no DC control current is required, the length of telephone line is determined only by the audio attenuation. The full gain of both the transmitter and receiver audio amplifiers can be used to overcome excessive line attenuation, permitting the use of long wire lines with the power line carrier audio termination circuits. Absence of DC control current also permits the use of telephone circuits with isolating transformers and/or telephone repeaters.

Automatic simplex voice circuits can be connected to duplex voice circuits, including local telephone switchboard facilities. Motorola power line carrier equipment is well suited to this application because frequency modulation and *automatic modulation control* eliminate most level variations in the audio channel caused by varying line conditions.

DUPLEX OPERATION

Duplex operation means that communication over the transmission path can occur in both directions at the same time. This is accomplished by using two different power line carrier frequencies; the transmitter and receiver at each station operating continuously. Communication is possible between two terminal stations or, in special instances, one master station and two or more "remote" stations (however, communication between "remote" stations must occur through the master station in this case).

Duplex operation is required for multiplexed continuous telemetering and, because of the opportunity for channel supervision, is desirable for such services as supervisory control, selective telemetering, and teleprinting. Motorola duplex power line carrier equipment is also capable of extending all standard telephone circuits as well as VHF base station control circuits and duplex VHF or microwave subcarrier channels (in an integrated communications system). The close channel spacing possible with Motorola equipment permits maximum utilization of the advantages of two-frequency duplex operation.

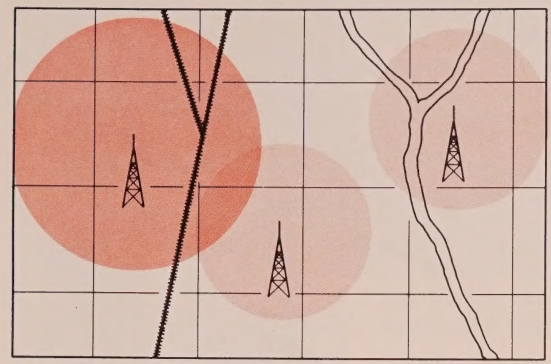


STANDARD DUPLEX TERMINAL IN FIXED-RACK CABINET

TELEPHONE TERMINATIONS

All three types of Motorola power line carrier terminals (manual simplex, automatic simplex, and duplex) provide termination facilities for a local two-wire telephone line. All terminals also contain a talking battery (24 or 40 VDC) and ringing voltage (85 volts, 60 cycles) supply. However, connections are provided for using an external source of talking battery and/or ringing voltage if desired. Motorola power line carrier equipment provides termination facilities for all standard types of telephone extension circuits.

Technical Bulletin E-111, available from the Technical Information Center, provides a detailed description of Motorola power line carrier equipment and includes complete telephone termination information.



DESENSITIZATION

One type of possible interference to communications systems is that caused by the presence of an extremely strong undesired RF signal at the receiving antenna location.

Intermodulation interference (Motorola "Newsgram", May-June, 1954) is a type of interference presented to VHF radio communications systems when two or more strong signals mix to produce a third signal on another channel. Closely allied to intermodulation and often associated with it is a second type of interference termed "desensitization". Desensitization, however, requires only a single strong signal and produces different results.

A receiver may have adequate selectivity to reject strong adjacent or alternate channel signals, i.e. the interfering signals will not be heard at the speaker. In fact, many communications receivers today have selectivity expressed in terms of 100 db. rejection at some point at the edge of or within the adjacent channel. However, this selectivity characteristic does not necessarily correct for desensitization, a type of interference which does not appear at the speaker.

SELECTIVITY

From a theoretical standpoint, placing all selectivity ahead of amplification in the receiver could virtually eliminate the desensitization problem. All undesired signals would then be reduced to negligible amounts before they encountered the non-linearities of vacuum tube amplifiers, mixers and detectors. However, from a practical standpoint, the answer is not this simple.

Each tuned circuit, even a high-Q tuned circuit, has a finite loss associated with it. The sum of these losses, if all selectivity preceded amplification, would be great enough to reduce receiver sensitivity and signal-to-noise ratio to an unacceptable level. The large volume required for a sufficient number of high-Q RF tuned circuits and their cost are also unacceptable. Hence, a compromise solution must be reached.

The "Sensicon" circuit used in Motorola receivers is based on the optimum performance characteristics required. For example, the silver ribbon wound coils of 160 mc. Uni-Channel Receivers and the Iso-Q Cavities of 160 mc. Sensicon receivers provide optimum rejection of undesired signals in the RF stages. Amplification in the RF and high frequency IF stages is maintained at a level sufficient to provide adequate sensitivity and signal-to-noise ratios but yet protect against desensitization and intermodulation. The Permakay Filter provides a barrier against undesired signals reaching the low frequency IF stages to create interference problems there.

Because it is today impractical to design a receiver with all of its selectivity before the RF amplifier section, there is a possibility of strong undesired signals reaching the RF and IF amplifier stages and mixers, even in high quality receivers. This, in turn, means that these signals can produce effects up to the stages where the major portion of the selectivity is realized.

DESENSITIZATION

Any vacuum tube amplifier subjected to excessive grid drive voltages will draw grid current and undergo a shift in operating point which reduces g_m. depending on the circuit used, this grid current will produce a grid self-bias voltage. When a high bias voltage exists, it takes a correspondingly larger signal voltage to overcome the bias voltage before the tube can act as an amplifier.

Because a strong interfering signal cannot be wholly eliminated from the RF stages or even the high frequency IF stages, this signal can produce grid bias voltages which require stronger than normal desired signals to overcome the bias. This reduces the effective receiver sensitivity to the desired signal.

The effect is principally noted in the second mixer stage. When the intermodulation threshold is exceeded by a strong undesired

signal, the gain in the second mixer is reduced to a degree dependent upon the signal strength because of the signal amplification prior to the second mixer. As the level of the undesired signal becomes extreme, the first mixer is also affected.

EXAMPLES

Desensitization presents no problems where antenna sites are plentiful. Even in congested areas, there is no problem if power levels are not excessive and there is adequate spacing between antennas of the various systems.

However, on one mountain-top in one of our western states, there are at present 28 separate radio transmitters ranging from 60 watt VHF communications transmitters to 50 kw. (effective radiated power) TV stations. On one tall building in a city on the eastern seaboard, there are now 21 antennas including several high powered TV stations. At both of these locations it is extremely difficult to find additional transmitter frequencies which will not produce problems of spurious and harmonic interference, intermodulation interference and desensitization.

It is obvious that 250 watts radiated from a transmitting antenna to a receiving antenna only a few feet away will have some effects even if the frequencies are widely separated. This relationship between transmitter power and receiver sensitivity represents a ratio of approximately 162 db. The undesired signal enters the receiver through the antenna lead-in, through the power input circuits and through radiation directly to the receiver cabinet and chassis.

Tuned cavities may be used for added desensitization protection.

PROTECTIVE MEASURES

The first principle to follow in avoiding desensitization, after choosing quality radio equipment, is choice of antenna location. Avoid a receiving antenna location which receives undesired signals at levels above the desensitization threshold. As a rule of thumb, if the undesired signal at the receiver input terminal is 60 db. or more above the desired signal sensitivity level the possibility of greater spacing between antennas should be investigated. While greater signals can be tolerated with little or no effect in a quality receiver, particularly at frequencies far from the desired frequency, the safety margin for adequate protection under adverse conditions is decreased.

For those situations where an alternate location is an impossibility, additional selectivity can be placed in front of the receiver RF stages. A tuned cavity with only ½ to 3 db. insertion loss can decrease the amount of desensitization by a considerably greater amount. In extreme cases, several cavities in series can be used.

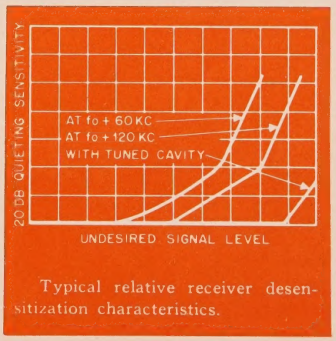
REPEATERS

Repeater systems wherein transmitters and receivers in the same or adjacent cabinets operate simultaneously sometimes present desensitization problems. It is difficult to attain distance between transmitting and receiving antennas and protection must also be provided from inter-cabinet and inter-chassis radiation as well. All current Motorola repeaters include the TK109 receiver shield and filter kit which protects the receiver from radiation entering it from other than the antenna lead-in.

A unique desensitization problem is encountered in some radio repeater systems. When a very weak signal (just sufficient to open squelch) is received, the receiver turns the transmitter on. However, if desensitization effects are present, the transmitter may desensitize the receiver so that the received signal is not heard, thus turning off the transmitter and initiating a 'cycling function. This is an example of another factor which must be taken into account in design of radio communications systems.

SUMMARY

While in a quality communications receiver such as the Motorola Sensicon or Uni-Channel receiver is designed to provide maximum protection from desensitization, it cannot completely eliminate the possibility of its occurrence. In any case where a receiver is subjected to high level interfering radiation, the possibility of desensitization should not be overlooked. Physical spacing is the best approach to the problem but when spacing cannot be achieved, tuned cavities may be of value.



Typical relative receiver desensitization characteristics.

TRANSMISSIONS . . . On Communications Topics

A New Swimming Pool Service?

At last reports, city officials at Haverhill, Mass. were considering the use of portable radiophones at Plug Pond swimming area for emergencies in case installation of regular telephone service between the area and the police station proved too expensive.

Radio Dispatched Cranes

Huge overhead cranes capable of lugging anything from machine tools to 12-ton B-47 wings have been equipped with two-way radio at one of Lockheed's plants. In the 45-acre main factory building, departments with tools, material or assemblies that need to be moved to another location merely call the central office for immediate service by the nearest of 24 overhead cranes. Until two-way radio was installed, all instructions had to be given to the crane operators by men on foot.

The cranes operate in all seven of the approximately 200-ft. long bays. Six of the bays can accommodate eight crane cabs at one time; the final assembly bay can handle 16 crane cabs if necessary.

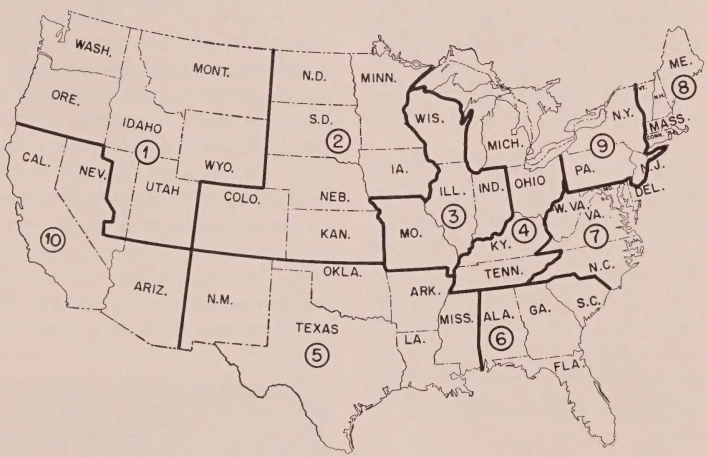
Two truck cranes, four yard cranes, 10 fork lifts, 10 tractors and three trucks have also been included in the new two-way radio control system at this plant. There are five radio dispatch points operating from the central transmitter—three for transportation and two for plant protection. Under the control of the Flight Operations Department, some 300 employees have so far been licensed to operate the radio system units.

When All Else Is Gone

The value of having two-way radio communications is particularly emphasized during emergencies such as the recent one brought on by Hurricane Carol in the Northeast. At least 220,000 telephones were reported out in Massachusetts, Rhode Island, New Hampshire, Vermont and Maine. Power lines were badly hit and line crews directed by radio worked day and night to repair breaks above and below the ground.

Bay State Civil Defense forces were pressed into operation, their radio systems providing the only means of communication to many places where telephone and electric service had been disrupted.

REGIONAL DIRECTORY . . .



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REGION 9
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RESPONSIBILITIES

Continued from page 7

telephone company's private radio system" which it is now making available to selected organizations. I'm afraid the licensee of such a system will suddenly wake up to the fact that what he has is not a system for which the telephone company is responsible, but one for which he is individually responsible and that he may have stated under oath, on an application which had been stuck under his nose for signature, that he controlled the system, which he in fact does not control.

All of the safety and special radio services in allocation hearings have requested, and have been given, frequencies suitable to satisfy in part their particular desires. In securing this allocation it was represented, among other things, that the common carrier communication system was inappropriate to meet their demands. The police and fire departments' pleas were that the frequencies could not be shared with people having other interests —that when a police or fire department wanted communication, it wanted it immediately and could not wait for some allegedly frivolous call to be completed, nor could it even wait to be connected through a switchboard operator. What happens to this argument if at some future date we find that the police departments are not in fact running their communication systems, but have turned them over to someone else and actually consider their communications systems as being in the same category as the private telephone exchange which they lease from the telephone company?

In still another field it is necessary to consider responsibilities in connection with your rights.

A view of the Motorola booth at the National Conference of Associated Police Communication Officers, Inc., which was held in Pittsburgh, Pa., August 10-13. Shown here are Lt. Hall, representing the State of Florida, Lowell White, Motorola Communications & Electronics, Inc., and Larry Smyth, State of Alabama.

All the radio users who have organized radio communication systems are repeatedly faced with requests to assume communication duties over and above those provided for under the philosophy by which frequencies are assigned. At the present moment, in so far as the police and fire departments are concerned, these requests stem largely from disaster and civil defense people and frequently are framed in such a manner as to make it extremely difficult for a chief to turn them down without assuming the label of obstructionist. You all know that a radio frequency channel, or for that matter any communication channel, has a limited capacity. Unfortunately, in the case of radio, when the channel capacity is reached there is no quick and convenient way of stringing another line to provide additional facilities.

As a result, if a police department or a fire department agrees to assume additional communication loads for the benefit of another interest, when disaster strikes it may be necessary to choose between the handling of the communications of the host or of the guest.

I am not talking about hypothetical cases. In one area in the recent nation-wide alert, arrangements had been made by the civil defense officials to use certain fire department equipment and the fire department frequency to handle civil defense communication requirements despite a contrary FCC policy. During the alert, much to the dismay of the civil defense officials, they found that the fire department was using the channel for fire department activities to such an extent that the civil defense had no communication time available for what they considered a major necessity.

In closing may I reiterate that the FCC does not wish to, nor should you permit it, to run your business, but I do remind you that although you have the right to run your communications as you please, within the limitation set forth in law and the rules and regulations (the end of the Irishman's nose), you should not forget in exercising the right of self-determination that the manner in which you exercise that right today may affect your ability to carry out your responsibilities at some future date.

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